of short length. A description of the remarkable negative or reversing action effected by the red rays on the sensitised plate, first observed by H. Draper, is found in Chapter XXXIV. A partial explanation of this very interesting fact is given by the results of experiments lately made by Capt. Abney (*Phil. Mag.*, January, 1878), which show that the image can be rendered undevelopable by the oxidation of the altered silver compound forming it. Chastaing has also recently announced that he finds rapidity of oxidation promoted by the red rays. It is thus easy to see that the sensitive salt of silver which had been altered in chemical composition by a slight exposure to white light, would become oxidised where the red rays fell upon it, and that, in consequence, where the dark Fraunhofer's lines in the ultra red spectrum fell, the plate would remain unaffected and the presence of these invisible bands would become apparent.

Another subject of great interest, that of the production of coloured photographic images, is being attacked experimentally by Capt. Abney. The results of the experiments in this direction by Becquerel and Niépce de St. Victor are well known, and many of the visitors to the Loan Exhibition will remember the coloured photograph of dolls dressed in coloured clothes shown by the latter chemist. Abney believes that these tints are rather to be ascribed to different stages of oxidation of the film, than, as has hitherto been supposed, to the colours of thin plates. Then, again, on the subject of the recent discoveries by Vogel, Waterhouse, and others, as to the production of a film sensitive to the red rays by the addition of a red dye to the collodion, Capt. Abney has something original to say. He has found that the addition of certain resins, albumin, and other organic bodies, when combined with silver, tends to lower the limit of the impressible spectrum and the place of maximum sensibility; so much so, indeed, that it is possible to obtain an unreversed impression of the thermal spectrum. A beam of light was allowed to pass through ruby glass, and the spectrum was then thrown on a resinised plate in the ordinary manner, and a visible impression of rays in the red was obtained far beyond the limit of the visible spectrum, as is seen by a figure in the volume.

Enough has been said to show the value of Capt. Abney's treatise both from the scientific and artistic points of view. If we are to speak on the part of amateur photographers we would express a hope that the subject of the explanation of defects in negatives and their cure may be more fully treated of in the next edition. It is perhaps difficult for an accomplished photographer like the author to appreciate the difficulties of a beginner in the art, but the mere mention of some of the defects met with in negatives does not always, as the author states, suggest the cure to minds unfamiliar with the niceties of manipulation and procedure which to the expert come as a matter of course. We congratulate Capt. Abney on the appearance of this most useful volume. H. E. R.

OUR BOOK SHELF

Archæological Researches at Carnac, in Britanny. By James Miln. (Edinburgh: David Douglas.)

THIS beautiful book reflects great credit on its author. It would be difficult in the recent literature of archæology to point out a more salient example of the great gain which is sure to accrue to that branch of science from the introduction of the true scientific spirit, and attention to details. Carnac, in most people's minds, is associated with Druidical circles, and it was to see the wonderful alignments there that Mr. Miln visited the place. But while in the region the author was particularly struck with the remains belonging to a very different time, which were pointed out to Mr. Miln by a French archæologist. They are termed the mounds of the Bossenno. With characteristic energy Mr. Miln, who was determined to explore, endeavoured to buy in order that he might explore the better. In this, however, he was foiled, beset by too many difficulties. The permission to explore which he subsequently obtained does not appear to have been a very complete one, and after this big book full of matter our author states that much still remains to be done.

The results of the excavations so carefully carried out by Mr. Miln show that we have here the remains of a Gallo-Roman settlement, and he has reconstructed for us out of its ashes the condition of the people in former times. He has been enabled to give us precise information as to their food and the degree of luxury in which they indulged. Their worship, their ceremonies, and modes of manufacture, and the exact times between which the colony was in a flourishing condition are also fully discussed. He traces the local worship of Venus Genetrix, at the Mont St. Michael, in a most interesting manner. One of the oldest constructions which remains in Britanny is the chapel of St. Agatha. On the vault of the apse a few years ago was discovered one of the most curious frescoes which the Romans have left in Britanny. It represents Venus rising from a blue sea, surrounded by fishes and dolphins. This church, now dedicated to St. Vener, is styled "Ecclesia Sancti Veneris" in a twelfth century charter.

The beautiful illustrations comprise not only almost everything which was found, but large coloured plates of the chief coloured designs rescued here and there.

All antiquaries will do well to lay to heart the remarks on ancient pottery made by Mr. Miln *à propos* of his finds in the excavation which he designates A. He shows abundantly how much caution is requisite in such inquiries and how a careful sifting of facts brings order into what at first sight appears a hopeless jumble of objects. It is curious that some of the pottery he found there is similar to some in the Guildhall Museum, which was found at a depth of forty-two feet, when the ground was excavated for the foundations of the Royal Exchange.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.*]

The Telephone

IN his interesting paper (NATURE, vol. xvii. p. 283) Mr. F. J. M. Page communicated as the result of his experiment to obtain indication of currents from a telephone by means of a mercury capillary tube, that the motion of the mercury was "always towards the end of the capillary." In the repetition of this experiment before the Physical Society on Saturday, February 16, Mr. Page found, however, that the mercury moved persistently in the opposite direction.

In the December (1876) number of the *Phil. Mag.* I showed that the motion of mercury in contact with dilute acid through which a current passes, is due to rapid circulation of the mercury set up by deoxidation of one part of its surface whilst another part is being oxidised; and that a very slight difference in the degree of oxidation is sufficient to produce an appreciable electromotive force.

When the mercury tube of the so-called electrometer is set up, the two surfaces of the mercury in contact with the acid are, I believe, almost always electrically unequal, that in the capillary being less oxidised than the other, and therefore positive to it. When the circuit is closed, a feeble current passes which, if it were strong enough, would move the mercury forwards. When a telephone is in action in the circuit, its equal and opposite currents combine alternately with the mercury current which strengthens the impulses in one direction and weakens those in the other; so that, whilst the sum of the telephone and mercury currents may be able to move the mercury in one direction, the difference of these currents is not able to move it in the other. Hence, I believe, arise the motions in question.

It of course follows that if, by accident, the potentials of the two mercury surfaces were equal, the telephone currents would produce no movement whatever in the mercury. Moreover if by variation of temperature, or by difference of strength of acid at the contact faces, or otherwise, the mercury surface in the capillary is rendered negative to the other surface, the accidental current set up will be in the opposite direction, and the tendency will be for the mercury to recede in the tube, as was observed in the experiment performed before the Physical Society.

Mr. Page's experiment will, I have no doubt, suggest a means of deducing the potentials of the telephone impulses.

ROBERT SABINE

AFTER reading the experiments of Prof. Forbes on the telephone, in NATURE, vol. xvii. p. 343, it occurred to me, as probably it has done to others, that this instrument might be employed in comparing the electrical resistances of wires. Accordingly, two weak cells were connected with the ordinary form of Wheatstone's bridge, and the telephone placed in the position usually occupied by the galvanometer. The current was rendered intermittent by a small electromagnetic apparatus belonging to an electric bell; the bell itself having been detached, the intermitter was placed in a separate room, and connected by long wires with the battery and bridge. The German silver wire of the bridge, having a resistance of ·2 ohms, was further lengthened at each end by resistance coils of ten ohms, and it was found that with a little practice one could easily compare two resistances of about two ohms within at least 1,000th of the true ratio.

It was found better to attach the sliding piece to the battery rather than the galvanometer, and it was exceedingly curious to notice the effect of moving the sliding piece so as to gradually diminish the difference of potential at the two terminals of the telephone, the sound diminishing until at last there seemed to be only a slight *uneasiness* produced in the ear, which ceased whenever the contact between the sliding piece and the German silver wire was broken. I have no doubt whatever that with a more delicate instrument than the one employed, which was apparently not nearly so sensitive as that used by Prof. Forbes, one could compare with considerable accuracy electrical resistances in this manner. Of course the telephone could also be employed instead of the galvanometer, in comparing the electromotive forces of batteries, and it is my intention to make more experiments in this direction.

By using a tuning-fork made to vibrate by electricity and a Helmholtz's resonator in conjunction with the telephone, the accuracy of testing may no doubt be largely increased.

HERBERT TOMLINSON

---

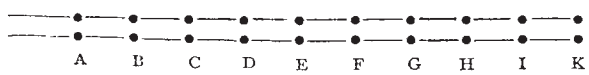
1. IF the cavities above and below the iron disc of an ordinary telephone are filled with wadding, the instrument will transmit and speak with undiminished clearness.

2. On placing a finger on the iron disc opposite the magnet, the instrument will transmit and speak distinctly. It only ceases to act when sufficient pressure is applied to bring plate and magnet into contact.

3. Connecting the centre of the disc by means of a short thread with an extremely sensitive membrane no sound is given out by the latter when a message is transmitted.

4. Ten telephones were connected as represented in the following diagram, on the principle of a battery joined for surface or quantity.

From transmitter—



A, B, C, &c., telephones.

On receiving a message from the transmitter *it could distinctly be heard through any of the ten instruments, although the current had been split up ten times.* (I have no doubt that a greater number of telephones might thus be joined with almost equal effect; from want of instruments I have not been able to find out the limit.)

The following experiments were made with a double telephone, constructed by a battery of horse-shoe magnets with iron cores at their ends. The wires on the bobbins were wound in opposite directions, as on an ordinary electro-magnet.

5. *On connecting the similar poles of the coils (as + and +) and joining the remaining similar poles (as — and —) to line wires the instrument both transmitted and spoke with equal distinctness.*

6. On placing the armature on the horse-shoe magnet no loss of power was perceptible in either transmitting or receiving, nor was there any increase of power on augmenting the number of magnets.

7. If the inner and outer coils of an induction coil are respectively connected with a transmitting and receiving instrument, sound can be distinctly transmitted in either direction.

8. If an ordinary Leyden jar is interposed in the line wire, one end being in contact with the inner, the other with the outer coating, sound can be transmitted, but it is much weakened in strength.

9. Bringing the iron cores of the double telephone in contact with the disc and pressing with the fingers against the plate on the other side, a weak current from a Daniell cell produced a distinct click in the plate, and on drawing a wire from the cell over a file which formed part of the circuit, a rattling noise was produced in the instrument.

Experiments No. 1, 2, 3, and 9 tend to show the absence of mechanical vibration. For the Experiments Nos. 4 and 5 I fail to find a reasonable explanation. No. 6 shows that strength of the magnet has nothing to do with the force of the sound produced, the latter being simply the result of a difference of two opposing forces. Nos. 7 and 8 require no explanation.

The above notes are taken from a paper read by me before the Priestley Club on February 16.

Bradford Grammar School AUREL DE RATTI

IN NATURE, vol. xvii. p. 164, there was a notice of a telephonic alarum in the shape of a tuning-fork. This, however, requires a fixed and special telephone. The following method of attracting attention requires neither. I venture to send it you, as I have seen no notice of any one having tried it; but I can scarcely believe it to be the case, as the thing would suggest itself to any one studying the instrument. It is to include a magneto-electric machine in the circuit, when turning the handle produces a series of taps in the telephone audible at a considerable distance. I have not tried it for any long distance—merely fifty yards. The magneto-electric machine was placed in the observatory, and the telephone, or rather a battery of three telephones, in my study. The noise was heard at the further end of my dining room, the door of which faces that of the study.

Rugby A. PERCY SMITH

EXPERIMENTING with a pair of telephones the other day, I thought I would try if it were possible to utilise underground pipes as conductors. I therefore connected one terminal of each instrument with the gas and the other with the water-pipes, in two houses placed about thirty yards apart, and found that it was possible to carry on conversation by means of the instruments thus connected. The voices were not as distinct as if wire had been used, but singing was very plainly heard. I have not had the opportunity of trying a longer distance; perhaps some of your readers may test the matter further.

Bury, Lancashire WILLIAM STOCKDALE

"Mimicry in Birds"

OWING to the special meaning of late attached to the word "mimicry" by naturalists, the above heading seems liable to mislead when applied to the fact mentioned by Mr. J. Stuart Thomson (page 361). In answer to his inquiry perhaps you will allow me to quote the following from the fourth edition of Yarrell's "British Birds" (vol. ii. p. 229) with respect to the starling.

"Its song is as imitative as that of the vaunted Mocking-bird,